attained by the *Turbinia,* the *Cobra,* and the *Viper* as indicative of success for the conditions obtaining in the merchant service.

In mercantile steamships high speeds are not generally desired, excepting for fast passenger boats, and, as has been said, the turbine gave its best efficiency at high speeds. On the other hand, a merchant vessel required a practically constant speed rate, and therefore turbine machinery could be designed to give highest efficiency for a fixed speed. It was found, however, that even with improved propeller design the lowest speed that was satisfactory for a direct-coupled unit was about 18 knots.

The main idea of the shipowner is ultimately one of economy, and it was only after some years that the turbine was eventually adopted for the merchant service.

The first applications were for high-speed vessels for passenger traffic, and from that intermediate speed vessels were fitted. The application in these was entirely successful, but it was not until the introduction of mechanical gearing that the problem of fitting turbine drives for low-speed vessels can be considered to have been successfully dealt with.

The first turbine merchant steamer was the *King EthcarJ,* which was u joint enterprise of Captain John Williamson, Messrs. Denny, and the Parsons Company. This boat was built in 1901. One high-pressure machine with four expansions was fitted to the centre shaft. The steam from this went to two low-pressure machines, one at each side, and in the same casing as these were incorporated the astern turbines. Originally two propellers were fitted to each of the wring shafts, but later a single propeller was fitted to each shaft. The actual turbine construction differed somewhat from that manufactured for war vessels. Heavier construction was used, and the turbine shaft did not go right: through the drum, but was shrunk into wheels carrying the drums. This boat was put in service in the estuary of the Clyde, doing about 180 miles steaming per day.

It was found that this vessel not only had a greater mileage and a higher speed, but that it burnt less fuel than other vessels on the same service,

and the coal consumption taken over a period of years was found to be nearly 20 per cent less than that of vessels of similar size and speed but fitted with) compound engines driving paddle-wheels.

The success of this turbine-driven boat was followed by the adoption of the drive for a number of vessels engaged in the cross-Channel service.

One of the great objections in the early evolution of the turbine for ship-drive was its non-reversibility, and in some of the earlier installations it is certain that the astern turbines were not powerful enough for their work. Nowadays, as a general rule, they are made much larger, and are usually capable of developing at least 50 per cent of the maximum power of the ahead turbines. The turbine has a greater power of stopping or reversing the direction of the ship than the reciprocating engine. Since at the moment of reversal the ahead turbine is still revolving the astern turbine in the ahead direction, the effective torque exercised by the steam admitted to the astern turbine is considerably greater than under normal running conditions, and